



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**DC MOTOR SPEED CONTROL USING MEASURED DISTANCE BY
ULTRASONIC SENSOR**

This report submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electronic Engineering Technology (Telecommunication) with Honours.

by

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This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Electronic Engineering Technology (Telecommunication) with Honours. The member of the supervisory is as follow:

.....

(Wan Haszerila Bte Wan Hassan)

ABSTRAK

Projek ini adalah berkaitan mengawal kelajuan DC motor secara automatik. Aplikasi projek ini adalah pada kenderaan automotif seperti kereta, lori dan juga kenderaan automotif yang lain. Projek ini berfungsi dengan meletakkan penderia ultrasonik pada bahagian hadapan kenderaan untuk mengukur jarak. Penderia ultrasonik akan mengukur jarak diantara kenderaan bagi mengelakkan perlanggaran yang boleh menyebabkan kemalangan. Jarak yang diukur oleh penderia ultrasonik kemudian akan dihantar kepada mikropengawal. Sekiranya jarak yang diukur kurang daripada 4 meter, secara automatik kelajuan kenderaan akan berkurangan. Maklumat jarak yang diterima oleh penderia ultrasonik juga akan dihantar ke paparan LCD untuk memberi maklumat kepada pemandu kenderaan.

ABSTRACT

This project is related to the DC motor speed control automatically. The project implementation is suitable at automotive vehicles such as cars, trucks and other automotive vehicles. The project works by placing ultrasonic sensors at the front of the vehicle to measure distance. The ultrasonic sensor will measure the distance between vehicles to avoid collisions that could cause an accident. The distances that measured by ultrasound sensors will be sent to the microcontroller. If the measured distance is less than 4 meters, the vehicle speed will automatically decrease. The distance information received by the ultrasonic sensor will also be sent to the LCD display to provide information to driver.

DEDICATION

To my beloved parent, Mr. Abu Bakar Bin Sahuni and Mrs. Hadini Bte Ashari thanks for the continuous moral support. Besides that, I would like to dedicated this project to my project supevisor, Puan. Wan Haszerila Bte Was Hassan that assists and guide me to develop this project. I also want to thanks to all my lectures and friends that help me to develop and completing this project.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

Cm	-	Centimetre
DC	-	Direct Current
Hz	-	Hertz
IO	-	Input Output
LCD	-	Liquid Crystal Display
RPM	-	Rotation per Minute
TTL	-	Transistor-Transistor Logic
V	-	Volt
m	-	Meter
us	-	Micro Second
mA	-	mili Ampere
m/s	-	meter per second
%	-	Percentage
<	-	less than
°	-	degree

CHAPTER 1

INTRODUCTION

1.0 Introduction

This chapter is discussed about project background, problem statement, objectives and work scope of the project.

1.1 Project Background

Ultrasonic sensor is the sensor that capable in measuring distance from its transmitter and back to its receiver. By using this work concept of the ultrasonic sensor, a system that can measure distance and control the direct current (DC) motor speed can be develop. The implementation of the system is on the automotive vehicle such as car and others. The concept of this project is to control the speed of the DC motor automatically. The speed of the DC motor is decreased if the ultrasonic sensor detects the range between the ultrasonic sensor and the front object is too close and possibly accident to occur.

Speed controlling in car usually controlled by the driver. This allow them either to increase the speed of the car or slow them down. Due to this factor, many car accident has happened day by day and year by year rapidly in the festive season. So that, it can be understand carelessness in controlling speed lead to car accident and cause fatal injuries. Besides that, the other factor is driver nowadays tend to lose focus and get distracted during driving. They tend to check the mobile phone during driving.

This factor also can cause accident to occur. So that, it is important to develop a system that help the car driver to control the car speed automatically and avoid accident.

The system also capable in create a safe driving environment, comfort driving situation for the road user and also more smooth traffic by having less accident on the road.

1.2 Problem Statement

In our daily life, car accident has been a serious problem. Many method have been carried out to solve this problem including the early education in driving car. Based on the study, the main cause of the car accident is driving at the high speed apart from other carelessness. Based on the statistic, for the year 2015 489,606 car accident have been recorded and lead to almost 7000 life lost in Malaysia. The statistic keep increasing until year 2016.

Thus, a system that will help in decreasing the number of the accident must be develop. By automatically control the speed of the car, it will help to avoid collision between cars on the road. This will also help in preventing the accident from occur also reducing injuries and life lost. Development of this system also, will help in create safety driving environment on the road.

Other than that, car accident also was causes by the factor that driver easily get distracted when driving. A small distraction such as using the mobile phone when driving also may cause a fatal injury. So that, this system will help keep the car in safe distance to avoid an accident.

At the place where the traffic capacity is very high, possibility that small accident will occur also very high. In our country, even a small accident can lead to very bad traffic congestion. So that, the implementation of this system also will help in reduce small accident.

1.3 Objectives

The objectives of this project are as below:

- i. To understand the ultrasonic sensor, Arduino board, DC motor and LCD display working principles.
- ii. To develop automatic DC speed control motor using ultrasonic sensor.
- iii. To analyse the performance of speed reduction using the DC motor and LCD display.

1.4 Work Scope

This project is about controlling the DC motor speed automatically. The implementation of this system is more suitable at the automotive vehicle such cars, buses and lorries. The installation of the ultrasonic sensor at the car will help in measuring the distance of an object in front of the car. This is including the other vehicle on the road, and also static object. The ultrasonic sensor work by transmitting the sound wave of 40kHz from the transmitter and measure the object distance. Then it will receive the reflected signal through the receiver. The measured distance then will be send to microcontroller unit. If the distance is less than 4m, the microcontroller will reduce the speed of the motor. The LCD display will help in giving notification about the distance and warning if an accident is possible to happen. Other than that, this system also will help in create safety driving environment. This project scope also covered the understanding about Arduino UNO as the main component in this project. The Arduino UNO module work along with the other input and output component such as ultrasonic sensor, DC motor and LCD display. The limitation of this project is controlling the DC motor speed using ultrasonic sensor.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter provides the understanding and related theory to this project. This is including the explanation about related component that will be used in this project. There is also previous researches on ultrasonic sensor distance measurement specification, mathematical calculation on distance measurement, ultrasonic control DC motor and also Arduino UNO as a microcontroller. Besides that, there is also experiment result related to this project are discussed in this chapter.

2.1 Road Accident Statistic in Malaysia 2015

In a developing country like Malaysia, the increasing number of vehicle mainly car cannot be avoided. This increasing number of car on the road, indirectly lead to increasing number of car accident. It can be said that, it is one of the cause that contribute to the increasing number of accident year by year. Based on the statistic from year 2006-2015, recorded by the Malaysian Ministry of Transportation it shows that, the number of the accident involve cars were very high.

Table 2.1: Malaysia accident statistic from year 2006 - 2015

Year	Motorcycle	Car	Van	Bus	Lorry	4 Wheel Drive	Taxi	Bicycle	Others	Total
2006	104,107	411,444	20,428	9,700	44,767	20,885	7,751	2,834	12,266	634,182
2007	111,765	426,941	21,109	10,285	47,696	21,823	8,809	2,690	14,909	666,027
2008	111,819	435,665	20,392	9,356	48,250	22,793	8,769	2,463	11,571	671,078
2009	113,962	472,307	19,220	9,380	46,724	23,581	8,669	2,486	9,294	705,623
2010	120,156	511,861	18,786	9,580	50,438	25,777	9,899	2,176	11,756	760,433
2011	129,017	546,702	17,916	9,986	53,078	30,828	11,197	2,033	16,394	817,151
2012	130,080	655,813	15,143	10,617	42,158	32,891	11,680	1,310	21,540	921,232
2013	121,700	632,602	17,148	10,213	39,276	52,512	11,651	1,370	15,441	901,823
2014	125,712	617,578	15,041	9,193	37,461	41,464	10,856	1,275	27,743	886,343
2015	123,406	625,758	14,585	8,804	34,942	46,163	9,591	1,119	29,924	894,274

Table 2.2: Total number of death and injuries from 2006-2015

Year	Total Number of Accident	Casualties			
		Death	Serious	Minor	Total
2006	341,252	6,287	9,253	19,885	35,425
2007	363,319	6,282	9,273	18,444	33,999
2008	373,071	6,527	8,868	16,879	32,274
2009	397,330	6,745	8,849	15,823	31,417
2010	414,421	6,872	7,761	13,616	28,269
2011	449,040	6,877	6,326	12,365	25,570
2012	462,423	6,917	5,866	11,654	24,439
2013	477,204	6,915	4,597	8,368	19,900
2014	476,196	6,674	4,432	8,596	19,704
2015	489,606	6,706	4,120	7,432	18,256

As can be observed from the Tables 2.1, accident involving cars give the higher contribution to the statistic. In driving car, not only the over speed may causes the accident but the other factor also should be considered. The other factor that should be considered is the driver easily get distracted while driving and lose control of the vehicle [1].

2.2 Ultrasonic Sensor

Ultrasonic sensor is a sensor that can be used to measure the distance between itself and the detected object. This sensor consists of transmitter and receiver enabling it to transmit the sound wave with the frequency more than 20kHz, which is beyond the human hearing ability. Ultrasonic sensor has been used widely in many electronic devices nowadays. One of the application of this sensor is as the distance measurement. In calculating the distance of an object, the ultrasonic sensor only can work properly if the sound wave transmits to the non-absorbable sound material. Meaning that it is only work if the receiver part of this sensor receives the reflected wave. The material that reflected wave is such as metal, glass or mould plastic.

Other than that, the ultrasonic sensor also has the time fly which the time is taken to measure the distance between the ultrasonic sensor transmitters back to the receiver. The standard ultrasonic sensor time to fly is about 344m/s in the air medium. The time to fly of the sound wave is recorded starting from the transmission back to the receiver. The distance measurement can be up to several meters.

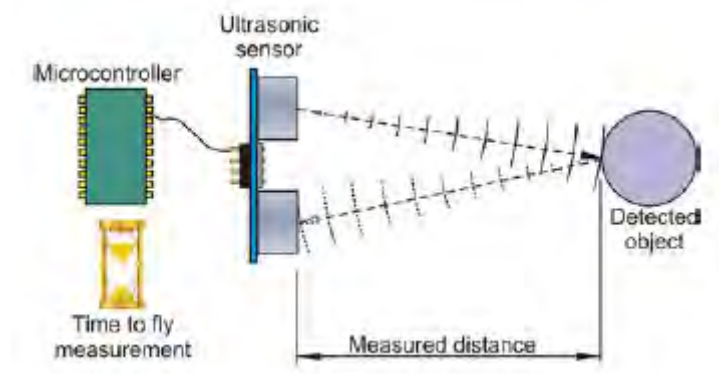


Figure 2.1: Ultrasonic sensor working principle

Based on the Figure 2.1, the ultrasonic sensor also only can detect the object with the bigger size. The ultrasonic sensor also has the work limitation which is cannot detect the smaller object.

2.2.1 Ultrasonic Sensor HR-SC04

The ultrasonic sensor HR-SC04 is the sensor that used in this project. This sensor has the capability in measuring the non-contact object. This sensor provides 2cm-400cm non-contact measurement function with the ranging accuracy up to 3mm. The basic principle of work is:

- i. This sensor using IO trigger for at least 10us high level signal
- ii. Automatically sends eight 40kHz and detect if there is a pulse signal back.
- iii. IF the signal back, through high level , time of high output IO duration is the time from sending ultrasonic to returning.

$$\text{Test distance} = (\text{high level time} \times \text{velocity of sound (340m/s)}) / 2$$

Table 2.3: Electrical parameter of ultrasonic sensor

Working Voltage	DC 5 V
Working Current	15mA
Working Frequency	40Hz
Max Range	4m
Min Range	2cm
Measuring Angle	15 degree
Trigger Input Signal	10uS TTL pulse
Echo Output Signal	Input TTL lever signal and the range in proportion
Dimension	45*20*15mm

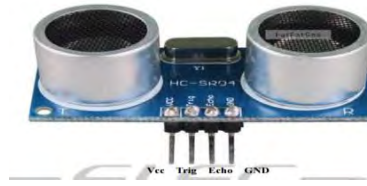


Figure 2.2: HC-SR04

Table 2.3 show electrical parameter of ultrasonic sensor and Figure 2.2 shows the physical design for the ultrasonic sensor model HC-SR04. This sensor model consists of 4 main pins which is Vcc, trig, echo and also GND. This sensor also has the two circles shape of transmitter and receiver.

2.3 Arduino Board

Many of the electronic device nowadays using the programming language and microcontroller to operate. The development of microcontroller gives benefit to human in the scope of safety, process control, work and many others. Arduino board is one of the microcontroller board that have been used widely nowadays. It is an open-source physical computing platform that enables software writing for the board. The Arduino board also can be used along with the other electronic component including switches, or sensor such as the ultrasonic sensor. The programming language that writes in the microcontroller usually used in controller component such as motor, LED and other related output.

Differ from other microcontroller programming kit, Arduino is much easier to program as it is only used the simply programming language (Arduino IDE) to make it operates the microcontroller. Different type of Arduino consists of different chip of microcontroller.

2.3.1 Arduino UNO Board

In programming the microcontroller in this project, the Arduino UNO board is used because this project only consists one input which is ultrasonic sensor and two output which is DC motor and LCD display.



Figure 2.3: Arduino UNO Board

Figure 2.3 show the physical form of the Arduino UNO circuit board. It is also including the pin description on the board. The Table 2.4 shows the technical specification for the Arduino Uno board.

Table 2.4: Arduino UNO technical specification

Parameter	Specification
Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB of which 0.5 KB used by bootloader

SRAM	2 KB
EEPROM	1 KB
Clock Speed	16 MHz

2.4 DC Motor

Dc motor is one of the electronic motor that operates by using the direct current to change its operation to mechanical energy. The DC motor also come in two type either electromechanical or fully electronic. These days, DC motor have been widely used along with the microcontroller. Usually the output of the DC motor can be controlled by using the microcontroller. In completing this project, the DC brush motor is used in proving the speed reduction process. DC brush motor worked by generates torque when received the DC power supply directly. Besides that, this motor is suitable in showing the simple control of motor speed.



Figure 2.4: DC motor

Figure 2.4 shows the physical form of the DC motor. The DC motor is used to reduce or maintain the speed.